



Rocky Mountain
Remediation Services, L.L.C.
... protecting the environment

Geoprobe Characterization Report for the OU-9 Pipe Excavation Project

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Prepared by

Rocky Mountain Remediation Services, L. L. C.

REVISION 0

August 8, 1996

DRAFT

Geoprobe Characterization Report for the OU-9 Pipe Excavation Project

1.0 Introduction

Due to its interference with Phase III of the Sewage Treatment Plant Upgrades, approximately 150 feet of the 6" vitrified clay pipe, designated as OU-9 was scheduled to be removed by excavation under a subcontract (Reference P.R. P498599). This project will be conducted within an operable unit, but is not considered to be an Environmental Restoration activity. Before excavation of the overburden began, watertight plugs were placed in the pipe on both sides of the section to be removed. Characterization of a composite of the pipe and associated soils was taken on 6/11/96 and 6/18/96 in accordance with the Waste Characterization and Management Plan for Excavation of OU-9 Piping (RMRS Memo Number GMA-002-96, dated May 7, 1996). The results and locations of the samples taken during field excavation are presented in Appendix A. Preliminary results indicated slightly elevated levels of radioactivity in the soil, however, no hazardous constituents were detected. Data for Total Metals, Volatile Organics Sweep, and Semi-volatile Organics are not presented in this report as the results demonstrated that these were non-detectable. Groundwater standing in the OU-9 trenches had elevated gross alpha/beta values. Due to the detection of radioactive contaminants in the soil in the proposed area of excavation, a sampling plan was developed to identify potential areas of radioactive contamination within the effluent tank construction zone. This report describes the methods utilized for collection of the soil samples and presents the results of the analysis.

2.0 Purpose and Scope

Due to the detection of radioactive contaminants in the soil in the proposed area of excavation for the Phase III Sewage Treatment Plant Upgrades, a sampling plan was developed to identify potential areas of radioactive contamination and areas that are considered to be clean; and to quantify the extent of contamination detected in the soils, where found. The intent of the sampling was to establish if contamination was narrowly confined to the vicinity of the pipe, in which case, the soil could be removed and the construction of the tanks could proceed; or broadly distributed at high concentrations, which would make the project economically unattractive. The results of the analysis would then be compared to the proposed Tier I and Tier II "Action Levels" being negotiated with the state described further below.

Radioactive soils at RFETS are managed as waste, or "clean" soils dependent upon the levels of isotopes present in the mixture. In addition, RFETS is currently in the process of negotiating "put-back" levels of contamination for sites which have slightly

elevated levels of radioactivity in the soils (reference Appendix D). Preliminary data on samples taken in the field indicated that the values obtained would be low enough to qualify as "put-back" levels; however a representative number of samples needed to be taken in a systematic manner in order to properly characterize the area to be excavated. The "Action Levels for Radionuclides in Soils for the Rocky Flats Cleanup Agreement" are presented below and in Appendix D.

3.0 Sampling Plan Summary

Prior to sampling, meetings were held with representatives from Radiological Engineering and Environmental Restoration to establish a viable plan for proceeding with the Geoprobe Sampling. The original plans called for sampling the soil column both above and below the water table; however during field sampling activities there were only two sample locations which encountered groundwater (D-4 and B-3) and field measurements demonstrated background contamination values for all 2' sections of the core samples taken.

A Grid System was established in the proposed Effluent Tank construction area during the week of July 8, 1996 area to identify sample points which would allow systematic sampling of the entire construction area and provide a unique alpha-numeric identifier for each sample. The nodes were set at 12.5 foot intervals at predetermined elevations (see Appendix B). Elevations from a topographic map were used to establish predetermined desired depths for Geoprobe core samples to be taken to the depth of tank construction. This method would allow for representative sampling of the areas identified for tank construction, and did not include areas outside the immediate construction zone. Appendix B shows the sample locations, depths and elevations associated with the geoprobe samples. The locations selected for sampling included Node Numbers A1, B5, B3, B4, C4, C7, D3, D4, D6, D7, E3, E5, E7, in addition the nodes which fell at C3 and C5 were previously sampled during the trenching of OU-9 on 6/11/96 and 6/18/96. Note that split samples were taken at B3 and B4 due to a percentage of these samples having a black sludge present. The sludge was physically separated from the soil sample in the field and segregated into separate sample containers. Groundwater samples from standing water were also taken on 6/11/96 in the C5 location and on 6/18/96 at the C3 location. These results are presented in Appendix C.

During sampling, all 2' sections of the core removed were first monitored with a hand-held probe and then monitored with the FIDLER® for radioactive contamination. An organic vapor detector was also used to monitor each section of the core for Industrial Hygiene purposes; however, no organics were detected. Each 2' core was monitored, swiped and composited (hand-mixed with a trowel) into a stainless steel

bucket, monitored again with the FIDLER®, and then a composite sample was taken from the bucket to represent the entire core from the node. The analysis requested included Alpha/Beta Screen, Gross Alpha/Beta, and Isotopics for radioactive isotopes included in the action levels for clean-up. Analytical and Quality Assurance procedures used by the Analytical Projects Office (APO) are standard methods and are described in detail in Appendix E.

4.0 Instrumentation

Soil samples were taken using a van mounted Geoprobe sampling rig further described in Section 5.0 of this report. Radiological contamination monitoring was performed in the field using hand-held probes for total fixed plus removable and removable alpha and beta/gamma contamination. The Field Instrument for the Detection of Low Energy Radiation (FIDLER) was also used to monitor equipment and soils during field sampling activities. Equipment was monitored for radiological contamination during sampling activities and the equipment decontaminated between each core taken.

5.0 Field Procedures

A van-mounted Geoprobe sampling rig was driven into the construction area on 7/16/96. The rig was used to collect a total of 13 cores from each location with depths ranging from 2' to 12'. Details on the sample depths and elevations is presented in Appendix B. The equipment was operated in accordance with procedure 4-S64-ER-OPS-GT.39 Push Subsurface Soil Sample. The samples were enclosed in liners contained within the sampling assembly. The cores from each two-foot interval were hand surveyed for radiological contamination prior to compositing the cores for a given node into a stainless steel container. The cores were mixed into a homogeneous mixture, hand-surveyed for contamination with a probe, and composited into a single sample container to be analyzed for Gross Alpha/Beta and Isotopics at the B881 laboratories.

Field screening and analysis was conducted for samples taken by the APO sampling team on 6/11/96 (location C5) and again on 6/18/96 (location C3). These samples were taken directly from the OU-9 trench and are presumed to have the highest levels of radioactive contamination present in the construction area (field measurements were 3000 to 5000 CPM).

6.0 Analytical Procedures

All analysis was performed by B881 Analytical Labs. Gross Alpha and Gross Beta activities are measured by evaporating an aliquot of the prepared sample onto a

counting planchet and counting the alpha and beta activities in a low background, thin windowed, gas proportional counter. Isotopics analysis is performed when isotopes are separated from the prepared sample using ion-exchange and chromatographic extraction techniques, followed by electrodeposition onto counting planchets, and then analyzed by alpha spectrometry. A detailed description of the methods and procedures used for performing Gross Alpha/Beta as well as Isotopics for the samples analyzed are presented in Appendix D.

7.0 Sampling Data

Sampling data is presented in Appendix A for all radioactive samples taken, including APO events for the OU-9 Trench on 6/11/96 and 6/18/96 and the Geoprobe samples taken during the week of 7/16/96. The highest values recorded for the site soils occurred at locations C5 and C3 trenches. Node C5 results included Plutonium 239/240 measurements of 1.72 pCi/g and Americium 241 at 6.49 pCi/g; Node sample C3 had sample results of 4.5 pCi/g for Pu 239/240 and 18.1 pCi/g for Am 241. Results for all other locations were low; Pu 241 ranged from .079 to .533 pCi/g and Am 241 from .066 to 1.72 pCi/g. Results for Uranium 233/234, 235 and 238 were all close to background values for this area.

Standing groundwater encountered during excavation of the OU-9 trenches had values of 77 pCi/g gross alpha and 18 pCi/g gross beta for water collected at C-5 on 6/11/96; and 370 pCi/g gross alpha and 150 pCi/g gross beta for the C-3 location collected on 6/18/96. These samples were reported to have a high degree of sediment in them. The samples were obtained after allowing groundwater to accumulate for several hours in the contaminated OU-9 trenches.

8.0 Summary and Conclusions

The intent of the sampling was to establish if contamination was narrowly confined to the vicinity of the pipe, in which case, the soil could be removed and the construction of the tanks could proceed; or broadly distributed at high concentrations, which would make the project economically unattractive. The results of the analysis would then be compared to the proposed Tier I and Tier II "Action Levels" being negotiated with the state as presented in Appendix D.

The highest values recorded for the site soils, as discussed previously, occurred at the locations C3 and C5 within the OU-9 trench area. Node C5 results included Pu 239/240 measurements of 1.72 pCi/g and Americium 241 at 6.49 pCi/g; Node sample C3 had samples results of 4.5 pCi/g for Pu 239/240 and 18.1 pCi/g for Am 241. Although these were the highest soil values recorded for the construction site, the values are still significantly below the "Hypothetical Resident Tier II Action Level

Ratio Sum to 15 mrem" as shown in the Tier II Action Level Table. These values are low enough to qualify as potential "put-back" levels for soils within the construction zone.

Results from the additional 13 nodes sampled have significantly lower values for gross alpha/beta and isotopics and are representative for background level typically found at the RFETS site. The exception was that nodes E3, E5 and D3 had higher than background levels for Am 241; however the reported values were still significantly lower than the Tier II action level for Am 241 of 40.4 pCi/g.

Groundwater results (Appendix C) collected from the OU-9 trenches at locations C5 and C3 demonstrated that for standing water in the trench, the values were above dischargeable levels. Due to the fact that these samples were collected after the water was allowed to stand for a few days in sediment, these results may not be representative of the groundwater for this area. Further sampling would need to be conducted during construction to properly characterize groundwater in the immediate area.

9.0 Recommendations

Review of the data indicates that there are slightly elevated values in the soil for gross alpha/beta and isotopics in the area of the OU-9 pipe excavation, specifically at locations C3 and C5. Groundwater associated with the OU-9 trench also demonstrated higher than dischargeable limits for gross alpha/beta. The additional 13 nodes sampled within the construction zone were all within background values with the exception of nodes E3, E5 and D3 which showed slightly elevated levels for Am 241. Note that all soils sampled were below the "put-back" values for Tier I and Tier II Action Levels.

The data indicates that the source of radioactive contamination is associated with the OU-9 pipe excavation and is probably related to releases from the pipe. Removal of the pipe and associated contaminated soil should proceed prior to the construction of the effluent tanks to thereby eliminate the source of contamination. Soils from this excavation should be segregated from "clean" soil to facilitate sampling the soils once excavated to determine radioactive levels for the excavated dirt in order for it to be properly managed.

Data from the construction areas outside of the OU-9 trench area indicate that the levels of radioactivity in soils are close to background and excavation in these areas could proceed as planned if soil is closely monitored during construction. Groundwater results in the construction area showed elevated gross alpha/beta levels, therefore run-off would need to be collected and monitored during construction to prevent releases from the site.

APPENDIX A
SOIL SAMPLE RESULTS

KAISER-HILL COMPANY, LLC.
 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
 P.O. BOX 464
 GOLDEN, COLORADO 80402

ENVIRONMENTAL LABORATORY
 BUILDING 881

RADIOCHEMISTRY GROSS ALPHA/BETA REPORT SDG NUMBER: 96L2568 DATE: 07/30/96

Gross Alpha/Gross Beta Analysis Results

NODE	APO ID	LIMS ID	Gross Alpha	Gross Beta	Units	QC Batch
A-1	C4745-001	117301	14 ± 4 MDA 5	23 ± 2 MDA 2	pCi/g	96AB144
B-5	C4746-002	117376	16 ± 3 MDA 4	19 ± 2 MDA 2	pCi/g	96AB144
B-3S	C4747-003	117436	15 ± 3 MDA 4	26 ± 3 MDA 3	pCi/g	96AB147
B-4S	C4748-004	117434	16 ± 3 MDA 3	24 ± 3 MDA 3	pCi/g	96AB147
B-3SL	C4749-005	117437	11 ± 3 MDA 3	24 ± 3 MDA 3	pCi/g	96AB147
B-4SL	C4750-006	117435	20 ± 4 MDA 4	31 ± 3 MDA 3	pCi/g	96AB147
B-4SL	C4750-006	117435 D	19 ± 3 MDA 4	28 ± 3 MDA 3	pCi/g	96AB147
C-4	C4751-007	117439	12 ± 3 MDA 3	22 ± 3 MDA 3	pCi/g	96AB147
C-7	C4752-008	117438	12 ± 3 MDA 3	23 ± 3 MDA 3	pCi/g	96AB147
D-4	C4753-009	117371	16 ± 4 MDA 6	24 ± 2 MDA 2	pCi/g	96AB144
D-3	C4754-010	117372	29 ± 5 MDA 5	24 ± 2 MDA 2	pCi/g	96AB144
D-3	C4754-010	117372 D	24 ± 4 MDA 5	23 ± 2 MDA 2	pCi/g	96AB144
D-7	C4755-011	117373	14 ± 3 MDA 4	20 ± 2 MDA 2	pCi/g	96AB144
D-6	C4756-012	117304	15 ± 4 MDA 5	21 ± 2 MDA 2	pCi/g	96AB144
E-3	C4757-013	117305	20 ± 4 MDA 6	24 ± 2 MDA 2	pCi/g	96AB144
E-5	C4758-014	117303	24 ± 5 MDA 6	23 ± 2 MDA 2	pCi/g	96AB144
E-7	C4759-015	117302	17 ± 4 MDA 6	23 ± 2 MDA 2	pCi/g	96AB144

10/38 8

RFETS
881 GENERAL LABORATORY
FAX FORM

Report: 96L2044

Date: 7/25/96

Distribution (FAX)

M. Aycock, 8244
 APO, 3400

From

K.M. Hagglund, x7799

Node	Lab Sample ID	Customer Sample ID	Gross Alpha Activity OV $\pm 2\sigma$ (MDA)	Gross Beta Activity OV $\pm 2\sigma$ (MDA)	Units
C-3	115743	C4237002	159 \pm 13	13 \pm 3	pCi/g
C-3	115743 D	C4237002	111 \pm 10	18 \pm 3	pCi/g

COMMENTS:

These data are for reanalyses of the soil sampled on 6/18/96. The reanalyses were performed upon customer request due to variability observed in the data from the initial analysis. The reanalysis data also exhibit more variability than is typically obtained with this method. This further substantiates the initial supposition that the sample matrix is heterogeneous and contains "hot" particles. The best estimate of activity in such matrices is generally the average of all of the analyses. The activities are reported based on dry weight of soil.

RFETS
881 GENERAL LABORATORY
FAX FORM

Report: 96L2044

Date: 6/20/96

Distribution (FAX)

A. Dennis/ M. Aycock, 8244
APO, 3400

From

K.M. Hagglund, x7799

Sampling on

6/11/96

Node	Lab Sample ID	Customer Sample ID	Gross Alpha Activity OV $\pm 2\sigma$ (MDA)	Gross Beta Activity OV $\pm 2\sigma$ (MDA)	Units
C-5 6/11	115255	96L204404 (Soil)	22 \pm 3 (4)	18 \pm 2 (1)	pCi/g
C-5	115255 D	96L204404 (Soil)	45 \pm 5 (6)	26 \pm 2 (2)	pCi/g
C-5	115255	96L204404 (Pipe)	0.7 \pm 0.1 (0.1)	0.1 \pm 0.1 (0.2)	pCi/g

COMMENTS:

These are final results. A complete, formal report will follow when all samples for this project submitted under report 96L2044 have been completed.

The poor precision between the duplicate analyses of the soil sample is likely due to non-homogeneous sample matrix. This heterogeneity was also observed in the isotopic analysis data. Upon request from the customer, the piece of pipe in the sample was analyzed as a separate sample. The pipe was analyzed for surface contamination by doing a hot, nitric acid leach of the pipe. No attempt was made to dissolve the pipe since the contamination would be expected to be primarily on the surface, if present. If you have any questions, please call.

12/19/96

General Lab, Building 881

Lab Number: 96L2044 AMENDED

Report Date: 7/31/96
Sample Date: 06/18/96RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROMETRY

NODE C-3	SAMPLE ID	URANIUM 238 (pCi/g)	BATCH #
	C423702	0.589 ± 0.064 (MDA 0.058)	ISO96-065
C-3	SAMPLE ID	URANIUM 235 (pCi/g)	BATCH #
	C423702	0.025 ± 0.013 (MDA 0.017)	ISO96-065
C-3	SAMPLE ID	URANIUM 234/233 (pCi/g)	BATCH #
	C423702	0.971 ± 0.082 (MDA 0.017)	ISO96-065

General Lab, Building 881

Lab Number: 96L2044
AMENDED

Report Date: 7/31/96
Sample Date: 06/18/96

C-3

RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROMETRY

NODE	SAMPLE ID	PLUTONIUM 239/240 (pCi/g)	BATCH #
C-3	C423702	4.5 ± 0.3 (MDA 0.038)	ISO96-065

	SAMPLE ID	AMERICIUM 241 (pCi/g)	BATCH #
C-3	C423702	18.1 ± 0.9 (MDA 0.036)	ISO96-065

14 12

General Lab, Building 881

Lab Number: 96L2044

Report Date: 6/21/96

X Sample Date: 06/11/96

RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROMETRY

Node	SAMPLE ID	URANIUM 238 (pCi/g)	BATCH #
C-5	96L204402 SOIL	0.624 ± 0.051 (MDA 0.008)	ISO96-056
C-5	96L204402 SOIL D	0.411 ± 0.033 (MDA 0.005)	ISO96-056
C-5	96L204402 PIPE	0.906 ± 0.060 (MDA 0.005)	ISO96-056

	SAMPLE ID	URANIUM 235 (pCi/g)	BATCH #
C-5	96L204402 SOIL	0.017 ± 0.006 (MDA 0.006)	ISO96-056
C-5	96L204402 SOIL D	0.019 ± 0.006 (MDA 0.005)	ISO96-056
C-5	96L204402 PIPE	0.032 ± 0.008 (MDA 0.005)	ISO96-056

	SAMPLE ID	URANIUM 234/233 (pCi/g)	BATCH #
C-5	96L204402 SOIL	0.571 ± 0.048 (MDA 0.006)	ISO96-056
C-5	96L204402 SOIL D	0.216 ± 0.022 (MDA 0.005)	ISO96-056
C-5	96L204402 PIPE	0.906 ± 0.060 (MDA 0.017)	ISO96-056

—Numbers have been corrected for
background - use as actual values.

—About one week for further samples

Rick . 5417 FAX COPY of PIAN

General Lab, Building 881

Lab Number: 96L2044

Report Date: 6/20/96

Sample Date: 06/11/96

RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROMETRY

C-5

Node	SAMPLE ID	PLUTONIUM 239/240 (pCi/g)	BATCH #
C-5	96L204402 SOIL	1.25 ± 0.05 (MDA 0.01)	ISO96-056
C-5	96L204402 SOIL D	1.72 ± 0.08 (MDA 0.01)	ISO96-056
C-5	96L204402 PIPE	0.024 ± 0.004 (MDA 0.006)	ISO96-066

	SAMPLE ID	AMERICIUM 241 (pCi/g)	BATCH #
C-5	96L204402 SOIL	4.54 ± 0.24 (MDA 0.02)	ISO96-056
C-5	96L204402 SOIL D	6.49 ± 0.31 (MDA 0.01)	ISO96-056
C-5	96L204402 PIPE	0.090 ± 0.021 (MDA 0.012)	ISO96-056

76 14

RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROMETRY

17428

A-1
A-1 D
B-5
D-4
D-7
D-6
E-3
E-5
E-7
D-3
B-3 S
B-3 S D
B-4 S
B-3 SL
B-4 SL
C-4
C-7

SAMPLE ID	URANIUM 238 (pCi/g)	BATCH #
C4745001	0.560 ± 0.061 (MDA 0.017)	ISO96-065
C4745001 D	0.588 ± 0.066 (MDA 0.049)	ISO96-065
C4746002	0.382 ± 0.051 (MDA 0.018)	ISO96-065
C4753009	0.586 ± 0.066 (MDA 0.019)	ISO96-065
C4755011	0.381 ± 0.052 (MDA 0.018)	ISO96-065
C4756012	0.544 ± 0.065 (MDA 0.053)	ISO96-065
C4757013	0.557 ± 0.065 (MDA 0.063)	ISO96-065
C4758014	0.555 ± 0.066 (MDA 0.065)	ISO96-065
C4759015	0.610 ± 0.070 (MDA 0.020)	ISO96-065
C4754010	0.594 ± 0.060 (MDA 0.015)	ISO96-069
C4747003	0.552 ± 0.058 (MDA 0.042)	ISO96-069
C4747003 D	*0.676 ± 0.075 (MDA 0.070)	ISO96-069
C4748004	0.535 ± 0.062 (MDA 0.018)	ISO96-069
C4749005	0.470 ± 0.056 (MDA 0.056)	ISO96-069
C4750006	0.792 ± 0.070 (MDA 0.015)	ISO96-069
C4751007	0.513 ± 0.058 (MDA 0.017)	ISO96-069
C4752008	0.500 ± 0.054 (MDA 0.015)	ISO96-069

* Passes at 3 sigma

17428

A-1
A-1 D
B-5
D-4
D-7
D-6
E-3
E-5
E-7
D-3
B-3 S
B-3 S D
B-4 S
B-3 SL
B-4 SL
C-4
C-7

SAMPLE ID	URANIUM 235 (pCi/g)	BATCH #
C4745001	0.025 ± 0.012 (MDA 0.017)	ISO96-065
C4745001 D	0.014 ± 0.010 (MDA 0.018)	ISO96-065
C4746002	0.033 ± 0.015 (MDA 0.018)	ISO96-065
C4753009	0.007 ± 0.016 (MDA 0.066)	ISO96-065
C4755011	0.027 ± 0.014 (MDA 0.018)	ISO96-065
C4756012	0.021 ± 0.016 (MDA 0.053)	ISO96-065
C4757013	0.034 ± 0.015 (MDA 0.019)	ISO96-065
C4758014	0.043 ± 0.017 (MDA 0.019)	ISO96-065
C4759015	0.045 ± 0.018 (MDA 0.020)	ISO96-065
C4754010	0.011 ± 0.008 (MDA 0.015)	ISO96-069
C4747003	0.051 ± 0.017 (MDA 0.015)	ISO96-069
C4747003 D	0.023 ± 0.013 (MDA 0.020)	ISO96-069
C4748004	0.040 ± 0.016 (MDA 0.018)	ISO96-069
C4749005	0.012 ± 0.012 (MDA 0.044)	ISO96-069
C4750006	0.034 ± 0.014 (MDA 0.015)	ISO96-069
C4751007	0.006 ± 0.014 (MDA 0.058)	ISO96-069
C4752008	0.016 ± 0.010 (MDA 0.015)	ISO96-069

S = SOIL
SL = SLUDGE

17 15

RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROMETRY

NODE	SAMPLE ID	URANIUM 233/234 (pCi/g)	BATCH #
A-1	C4745001	0.523 ± 0.059 (MDA 0.017)	ISO96-065
A-1D	C4745001 D	0.649 ± 0.070 (MDA 0.049)	ISO96-065
B-5	C4746002	0.421 ± 0.054 (MDA 0.018)	ISO96-065
D-4	C4753009	0.614 ± 0.069 (MDA 0.052)	ISO96-065
D-7	C4755011	0.340 ± 0.049 (MDA 0.018)	ISO96-065
D-6	C4756012	0.652 ± 0.072 (MDA 0.053)	ISO96-065
E-3	C4757013	0.763 ± 0.076 (MDA 0.052)	ISO96-065
E-5	C4758014	1.19 ± 0.10 (MDA 0.06)	ISO96-065
E-7	C4759015	0.843 ± 0.084 (MDA 0.056)	ISO96-065
D-3	C4754010	0.634 ± 0.062 (MDA 0.015)	ISO96-069
B-3S	C4747003	0.518 ± 0.056 (MDA 0.015)	ISO96-069
B-3S	D C4747003 D	0.488 ± 0.062 (MDA 0.020)	ISO96-069
B-4S	C4748004	0.488 ± 0.059 (MDA 0.018)	ISO96-069
B-3SL	C4749005	0.567 ± 0.060 (MDA 0.016)	ISO96-069
B-4SL	C4750006	0.821 ± 0.071 (MDA 0.015)	ISO96-069
C-4	C4751007	0.594 ± 0.063 (MDA 0.017)	ISO96-069
C-7	C4752008	0.594 ± 0.059 (MDA 0.015)	ISO96-069

S = SOIL
SL = SLUDGE

RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROMETRY

SAMPLE ID	PLUTONIUM 239/240 (pCi/g)	BATCH #
C4745001	0.079 ± 0.018 (MDA 0.026)	ISO96-065
C4745001 D	0.111 ± 0.021 (MDA 0.010)	ISO96-065
C4746002	0.021 ± 0.013 (MDA 0.040)	ISO96-065
C4753009	0.076 ± 0.020 (MDA 0.014)	ISO96-065
C4755011	0.053 ± 0.017 (MDA 0.014)	ISO96-065
C4756012	0.107 ± 0.022 (MDA 0.030)	ISO96-065
C4757013	0.025 ± 0.012 (MDA 0.032)	ISO96-065
C4758014	0.533 ± 0.051 (MDA 0.039)	ISO96-065
C4759015	0.197 ± 0.029 (MDA 0.026)	ISO96-065
C4754010	1.47 ± 0.12 (MDA 0.032)	ISO96-069
C4747003	0.144 ± 0.028 (MDA 0.036)	ISO96-069
C4747003 D	0.166 ± 0.027 (MDA 0.040)	ISO96-069
C4748004	0.004 ± 0.009 (MDA 0.036)	ISO96-069
C4749005	0.023 ± 0.009 (MDA 0.009)	ISO96-069
C4750006	0.007 ± 0.008 (MDA 0.032)	ISO96-069
C4751007	0.086 ± 0.018 (MDA 0.026)	ISO96-069
C4752008	0.317 ± 0.038 (MDA 0.034)	ISO96-069

SAMPLE ID	AMERICIUM 241 (pCi/g)	BATCH #
C4745001	0.066 ± 0.015 (MDA 0.009)	ISO96-065
C4745001 D	0.069 ± 0.019 (MDA 0.034)	ISO96-065
C4746002	0.080 ± 0.017 (MDA 0.024)	ISO96-065
C4753009	0.132 ± 0.028 (MDA 0.040)	ISO96-065
C4755011	0.068 ± 0.018 (MDA 0.037)	ISO96-065
C4756012	0.352 ± 0.044 (MDA 0.012)	ISO96-065
C4757013	1.48 ± 0.10 (MDA 0.03)	ISO96-065
C4758014	1.72 ± 0.11 (MDA 0.03)	ISO96-065
C4759015	0.370 ± 0.039 (MDA 0.024)	ISO96-065
C4754010	6.18 ± 0.34 (MDA 0.04)	ISO96-069
C4747003	0.156 ± 0.025 (MDA 0.010)	ISO96-069
C4747003 D	0.167 ± 0.026 (MDA 0.010)	ISO96-069
C4748004	0.020 ± 0.009 (MDA 0.011)	ISO96-069
C4749005	0.029 ± 0.013 (MDA 0.034)	ISO96-069
C4750006	0.013 ± 0.013 (MDA 0.048)	ISO96-069
C4751007	0.065 ± 0.016 (MDA 0.026)	ISO96-069
C4752008	0.064 ± 0.017 (MDA 0.028)	ISO96-069

S = SOIL

SL = SLUDGE

RADIOCHEMISTRY REPORT
ISOTOPIC ANALYSIS RESULTS BY ALPHA SPECTROSCOPY

Quality Assurance/Quality Control Data

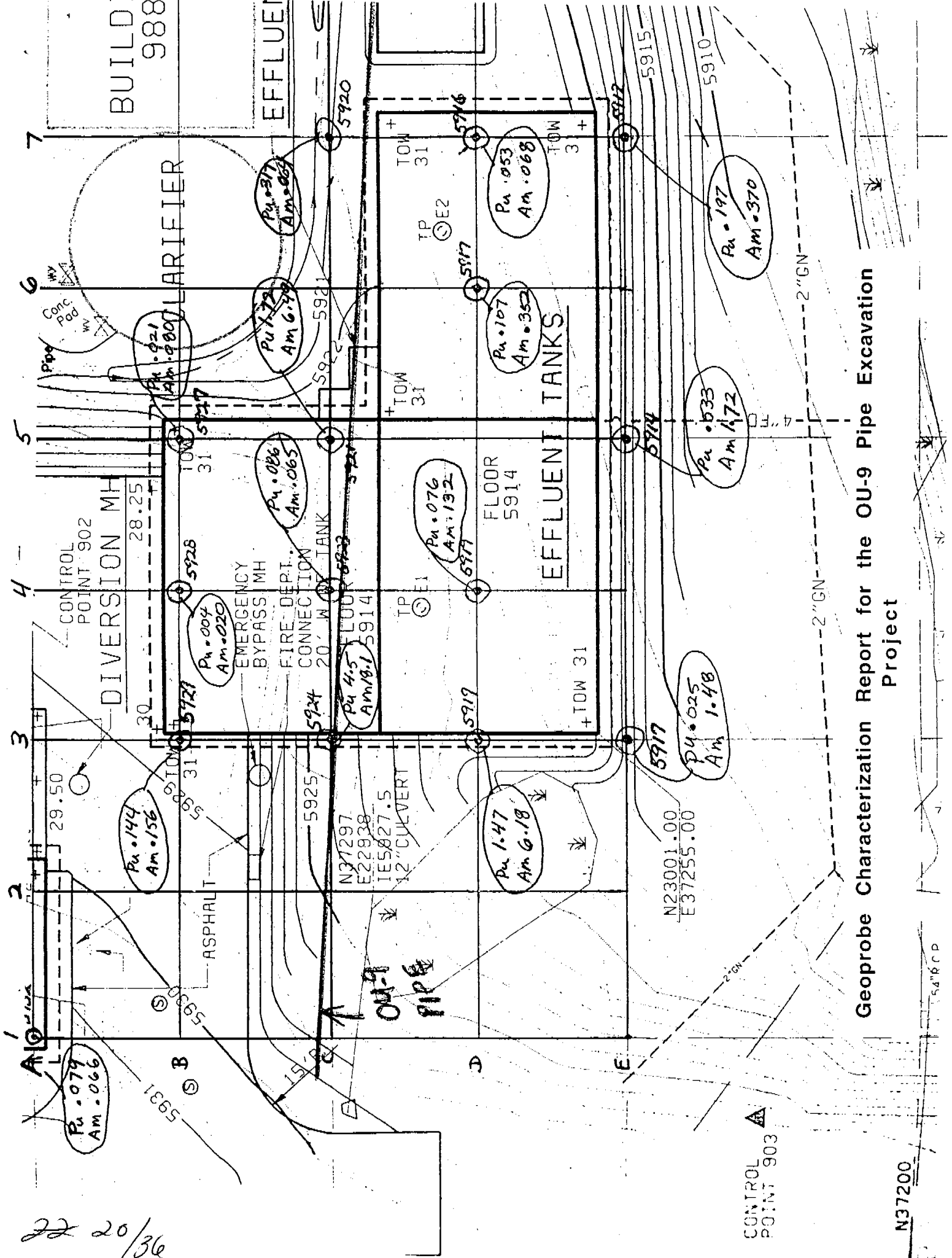
ANALYSIS		CSL CONTROL		CONTROL STANDARD (d/m/ml)	
BATCH #	DATE	ID NUMBER	ISOTOPE	OBSERVED VALUE	STANDARD VALUE
ISO96-065	7/30/96	CSL 610796	U-238	*10.9 ± 0.8	9.8 ± 0.5
ISO96-065	7/30/96	CSL 610796	U-233/234	10.4 ± 0.5	10.1 ± 0.5
ISO96-069	8/5/96	CSL 610796	U-238	10.6 ± 0.5	9.8 ± 0.5
ISO96-069	8/5/96	CSL 610796	U-233/234	10.0 ± 0.4	10.1 ± 0.5
ISO96-065	7/30/96	CSL 650165	PU-239/240	1.89 ± 0.12	2.04 ± 0.04
ISO96-069	8/5/96	CSL 650165	PU-239/240	1.89 ± 0.13	2.04 ± 0.04
ISO96-065	7/30/96	CSL 610720	AM-241	2.13 ± 0.13	2.02 ± 0.02
ISO96-069	8/5/96	CSL 610720	AM-241	*2.20 ± 0.20	2.02 ± 0.02

* Passes at 3 sigma

REAGENT BLANK					
BATCH #	DATE	ID NUMBER	ISOTOPE	ACTIVITY	UNITS
ISO96-065	7/30/96	U96-501-065	U-238	0.000 ± 0.011	pCi/g
ISO96-065	7/30/96	U96-501-065	U-233/234	0.061 ± 0.022	pCi/g
ISO96-069	8/5/96	U96-544-069	U-238	0.020 ± 0.012	pCi/g
ISO96-069	8/5/96	U96-544-069	U-233/234	0.047 ± 0.020	pCi/g
ISO96-065	7/30/96	PU96-501-065	PU-239/240	0.014 ± 0.010	pCi/g
ISO96-069	8/5/96	PU96-544-069	PU-239/240	-0.004 ± 0.010	pCi/g
ISO96-065	7/30/96	AM96-501-065	AM-241	0.038 ± 0.012	pCi/g
ISO96-069	8/5/96	AM96-544-069	AM-241	0.000 ± 0.005	pCi/g

20/88 18

APPENDIX B
SAMPLE LOCATIONS AND DEPTHS



Geoprobe Characterization Report for the OU-9 Pipe Excavation Project

N37200

CONTROL POINT 903

22 20/36

Date	Node	Depth	Elevation	Field Survey	Gross Alpha pCi/g	Gross Beta pCi/g	Pu 239/240 pCi/g	Am 241 pCi/g
6/11/96	C-5	9'	5923'	<5000 CPM	45	26	1.72	6.49
6/18/96	C-3	12'	5924'	<5000 CPM	159	13	4.5	18.1
7/16/96	E-3	5'	5917'	BACKGROUND	20	24	0.025	1.48
7/16/96	E-5	2'	5914'	BACKGROUND	24	23	0.533	1.72
7/16/96	E-7	1'	5912'	BACKGROUND	17	23	0.197	0.37
7/16/96	D-6	5'	5817'	BACKGROUND	15	21	0.107	0.352
7/17/96	D-3	7'	5919'	BACKGROUND	29	24	1.47	6.18
7/17/96	D-4	7'	5919'	BACKGROUND	16	24	0.076	0.132
7/17/96	D-7	4'	5916'	BACKGROUND	14	20	0.053	0.068
7/17/96	B-4	12'	5928'	BACKGROUND	16	24	0.004	0.02
7/17/96	B-5	12'	5927'	BACKGROUND	16	19	0.021	0.08
7/18/96	B-3	12'	5927'	BACKGROUND	15	26	0.144	0.156
7/18/96	C-4	11'	5923'	BACKGROUND	12	22	0.086	0.065
7/18/96	C-7	8'	5920'	BACKGROUND	12	23	0.317	0.064
7/16/96	A-1	12'	5931'	BACKGROUND	14	23	0.079	0.066

12-58

APPENDIX C
GROUNDWATER RESULTS

JUL-23-96 TUE 8:38

GENERAL LABORATORY 881

FAX NO. 303 968 4365

P. 01/02

96L2144

881 GENERAL LAB
INCIDENTAL WATERS - RADIOCHEMISTRY RESULTS

TO: IAN PATON FAX: 8482
APO FAX: 3400

FROM: K. HAGGLUND X7799
K. HARWARD X7128

[illegible]

COMMENTS:

These are final results. Sample contained
a lot of sediment. Formal report to follow.
K. M. Hazelwood

TRENCH AT LOCATION C-3 (WEST) 6/18

27 25

APPENDIX D

**ACTION LEVELS FOR RADIOACTIVE NUCLIDES IN SOILS FOR THE
ROCKY FLATS CLEANUP AGREEMENT**

R.S. Roberts

**ACTION LEVELS FOR RADIONUCLIDES IN SOILS
FOR THE
ROCKY FLATS CLEANUP AGREEMENT**

PRELIMINARY DRAFT

**US DEPARTMENT OF ENERGY
US ENVIRONMENTAL PROTECTION AGENCY
COLORADO DEPARTMENT OF PUBLIC HEALTH AND THE ENVIRONMENT**

JUNE 27, 1996

REVIEWED FOR CLASSIFICATION

BY S. L. CUNNINGHAM

Date 6/26/96 CMV
Public Release ok

27 27

**TABLE ES-1
SOIL ACTION LEVELS**

Tier I Action Level - Hypothetical Resident

Radionuclide	Hypothetical Resident Tier I Action Level 85 mrem (a) (pCi/gram)	Hypothetical Resident Tier I Action Level Ratio Sum to 85 mrem (b) (pCi/gram)
Americium-241	229	145
Plutonium-239/240	2001	728
Uranium-234	2042	
Uranium-235	136.8	
Uranium-238	613.9	

Tier I Action Level - Office Worker

Radionuclide	Office Worker Tier I Action Level 15 mrem (pCi/gram)	Office Worker Tier I Action Level Ratio Sum to 15 mrem (a) (pCi/gram)
Americium-241	227.7	130.8
Plutonium-239/240	1536	653.9
Uranium-234	2003	
Uranium-235	114.7	
Uranium-238	533.6	

Tier II Action Level - Hypothetical Resident

Radionuclide	Hypothetical Resident Tier II Action Level 15 mrem (pCi/gram)	Hypothetical Resident Tier II Action Level Ratio Sum to 15 mrem (a) (pCi/gram)
Americium-241	40.4	25
Plutonium-239/240	353.2	128
Uranium-234	360.4	
Uranium-235	24.1	
Uranium-238	108.3	

(a) - This applies to single radionuclides only which does not exist at RFETS. The "Sum of Ratios" method will be applied at RFETS so that multiple radionuclides are correctly assessed.

(b) - This assumes that the Am-241/Pu-239 activity ratio equals 0.20 and that only Pu-239 and Am-241 are present

30/38 28

APPENDIX E

LABORATORY ANALYTICAL METHODS

KAISER-HILL COMPANY, LLC.
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
P.O. BOX 464
GOLDEN, COLORADO 80402

ENVIRONMENTAL LABORATORY
BUILDING 881

CASE NARRATIVE

SDG NUMBER: 96L2568
DATE: 07/30/96
DATA PACKAGE: RADIOCHEMISTRY GROSS ALPHA/BETA ANALYSIS REPORT

SAMPLE DESCRIPTIONS:

<u>APO ID</u>	<u>Bottle #</u>	<u>LIMS #</u>
C4745-001	96L2568-01	117301
C4746-002	96L2568-02	117376
C4747-003	96L2568-03	117436
C4748-004	96L2568-04	117434
C4749-005	96L2568-05	117437
C4750-006	96L2568-06	117435
C4751-007	96L2568-07	117439
C4752-008	96L2568-08	117438
C4753-009	96L2568-09	117371
C4754-010	96L2568-10	117372
C4755-011	96L2568-11	117373
C4756-012	96L2568-12	117304
C4757-013	96L2568-13	117305
C4758-014	96L2568-14	117303
C4759-015	96L2568-15	117302

Method Summary

Gross alpha and gross beta activities are measured by evaporating an aliquot of the prepared sample onto a counting planchet and counting the alpha and beta activities in a low background, thin-windowed, gas flow proportional counter. Organics or combustible solids are ashed, the residue dissolved in acid, and the solution or an aliquot of the solution is evaporated onto a counting planchet. Aqueous samples are concentrated and then evaporated onto a counting planchet. Soil and sludge samples are initially prepared for analysis as described in L-6298, "Initial Preparation of Soils, Sludges, and Sediment for Dissolution." Analysis of aqueous samples and prepared non-aqueous samples is described in detail in Rocky Flats Procedure, L-6240, "Sample Preparation for Analysis of Gross Alpha-Gross Beta Activity in Aqueous Samples." Preparation of oils, solvents and other combustible organics is described in L-6194, "Preparation of Oils and Solvents for Analysis of Gross Alpha and Gross Beta Activity." The counting procedure is described in procedure L-6295, "Operation of the Tennelec LB4100 Gas Proportional Counters."

32 30/36

KAISER-HILL COMPANY, LLC.
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
P.O. BOX 464
GOLDEN, COLORADO 80402

ENVIRONMENTAL LABORATORY
BUILDING 881

RADIOCHEMISTRY GROSS ALPHA/BETA REPORT SDG NUMBER: 96L2568 DATE: 07/30/96

Method Summary (continued)

The detector counting efficiency and self-absorption effects of the salt residue on the planchet are determined from calibration curves which are generated by counting several planchets prepared with a known amount of alpha or beta activity and increasing amounts of salt (0 to 100 mg). Americium-241 is used as the spike for the alpha curves and a solution of Sr-90, Y-90 is used for the beta curves. These standards are traceable to the National Institute of Standards Technology (NIST).

The theoretical minimum detectable activity (MDA) for the analysis is based on the detector background, detector efficiency and self-absorption effects, count time and quantity of sample analyzed. The MDA for each analysis is calculated and is also reported. If the reported result is based on the average of two or more counts, the average MDA is reported.

Quality Control Summary

A sample batch consists of eleven or fewer samples, a duplicate of one of the samples, an alpha and a beta laboratory control sample, and a preparation blank. Each set of samples forms a "QC Batch" and is assigned a QC batch number. A sample can be traced back to its corresponding quality control samples through the QC Batch number.

The preparation blank (PB), an aliquot of deionized, distilled water, is prepared and analyzed with the samples to confirm that the samples were not contaminated during the analysis. The activities reported for samples and standards were not corrected for preparation blank activity.

The alpha and beta laboratory control samples are aqueous standards of ^{241}Am and ^{90}Sr , respectively. The standards are prepared by RFETS Chemistry Standards Laboratory (CSL) and are NIST traceable.

The duplicate, designated as the sample ID followed by a "D", is a second aliquot of one of the samples in the QC Batch which is carried through the procedure as a separate sample. If the duplicates for any QC Batches referred to in this report were performed on samples other than those in this report, the Narrative section will reference the report which contains the data from the duplicate analysis.

The instrument QC includes determining instrument backgrounds weekly, counting a control standard on each detector weekly, and counting an instrument check source daily on the Tennelec LB4100 multidetector gas proportional counters. The instrument backgrounds are based on the average of at least five, and normally ten or more, 4 hour counts. The control standard, prepared from an EPA-EMSL-LV crosscheck sample, is counted weekly to verify the accuracy of the calibration curves and instrument backgrounds. Instrument check sources are counted daily to verify that the efficiencies of the detectors have not changed. This information is available in the laboratory archives.

88 31

KAISER-HILL COMPANY, LLC.
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
P.O. BOX 464
GOLDEN, COLORADO 80402

ENVIRONMENTAL LABORATORY
BUILDING 881

RADIOCHEMISTRY GROSS ALPHA/BETA REPORT SDG NUMBER:96L2568 DATE: 07/30/96

Significant Figures

The results are reported to the nearest 0.01 pCi for activities less than 0.1 pCi, to the nearest 0.1 pCi for activities from 0.1 to 1 pCi and to the nearest 1 pCi or pCi for activities from 1 to 99 pCi. The measurement uncertainties, denoted as +/-, are reported at 2 sigma, unless otherwise noted.

Definition of Data Qualifiers

Data qualifiers have not been defined for reporting radiochemical data.

Exceptions or Deviations to Base Methods

The procedure is based on EPA SW-846 methods. Analysis of sample matrices other than aqueous samples is not discussed in SW-846. Preparation methods for other sample matrices will be discussed in the Narrative section of the report, if necessary.

Narrative

These samples were analyzed using procedures L-6298, "Initial Preparation of Soils, Sludges, and Sediment for Dissolution", and L-6240, "Sample Preparation for Analysis of Gross Alpha-Gross Beta Activity in Aqueous Samples." The counting procedure is described in procedure L-6295, "Operation of the Tenelec LB4100 Gas Proportional Counters." Activities are based on dry weight of sample.

The samples were analyzed in QC batches 96AB144 and 96AB147. There were no problems noted with these analyses and all QC data were acceptable.

34 32

KAISER-HILL ROCKY FLATS, INC.
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
P.O. BOX 464
GOLDEN, COLORADO 80402

GENERAL LABORATORY
BUILDING 881

RADIOCHEMISTRY ISOTOPICS REPORT

SDG NUMBER: 96L2568

DATE: 07-30-96

Method summary

Depending upon the sample matrix, pretreatment of the sample (as determined by the responsible chemist) may be required to obtain an aqueous solution which is necessary to perform the isotopic separation chemistry. Plutonium (Pu-239,240), uranium (U-233,234, U-235 and U-238) and americium (Am-241) isotopes are separated from the prepared sample using ion-exchange and chromatographic extraction techniques, followed by electrodeposition onto counting planchets, and analyzed by alpha spectrometry. Each sample is spiked with a Chemistry Standards Laboratory (CSL) certified tracer of an isotope (Pu-242, U-232 or Cm-244) which behaves chemically identical to the analyte (Pu-239, U-234, -235, -238 or Am-241) and whose alpha energy can be isolated with no other alpha interference's. Procedure L-6235, "Isolation of Plutonium, Americium and Uranium From Aqueous Samples" and L-6266, "Analysis of U, Pu, and Am in Soil/Sludge, Sediment by Ion Chromatography and Extraction Chromatography," are used to perform the isotopic separations. The areas of the tracer and analyte peaks or regions of interest are ratioed and the analyte activity in disintegrations per minute (dpm) is solved from the proportion. All analyte and tracer peak areas in counts per minute (cpm) are corrected for the detector background cpm in the particular region of interest. In addition, since the standard tracers are not isotopically pure and may contain small quantities of the analyte, a preparation blank is required with each batch of samples for each analyte. The blank consists of the tracer aliquot only, and from it, the amount of interferant is quantitated. The sample's analyte activity in dpm is then corrected for the preparation blank and the result in Pico-curies per liter or per gram (pCi/L or pCi/g) is calculated using the blank corrected dpm and the sample volume or weight analyzed. For Environmental Restoration samples the blank consists of the tracer aliquot only, and from it, the amount of interferant is quantitated, but the sample results are not blank corrected. However the blank results are reported.

KAISER-HILL ROCKY FLATS, INC.
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
P.O. BOX 464
GOLDEN, COLORADO 80402

GENERAL LABORATORY
BUILDING 881

RADIOCHEMISTRY ISOTOPICS REPORT

SDG NUMBER: 96L2568

DATE: 07-30-96

Quality Control Summary

The samples are analyzed in batches where each batch consists of a maximum of 9 samples, a preparation blank, a CSL certified control and a laboratory duplicate (at least 10 percent of the samples are analyzed in duplicate). Again, each of these is spiked with a known quantity of standard tracer. The batch in which a sample was analyzed is denoted by the "Batch #" and all quality control samples are traceable to any particular sample by the QC batch number.

The MDA (minimum detectable activity) for this analytical method is dependent on the uncertainty of the preparation blank activity, for Environmental Restoration samples the MDA for this analytical method is dependent on the detector background. Both methods are also dependent on detector efficiency, chemical recovery and volume or weight of sample analyzed. The chemical recovery represents the percentage of standard tracer that was recoverable through the sample preparation process. The result uncertainty is calculated by propagation of the uncertainties due to counting statistics of the sample and of the preparation blank. The uncertainties are stated at the two sigma level.

Significant Figures

The results and uncertainties are reported in pCi/l or pCi/g as follows:

<u>Sample Raw Result</u>	<u>Reported Sample Result and Uncertainty</u>
<1.0	nearest thousandth digit (0.001)
1.0 to 9.9	nearest hundredth digit (0.01)
10.0 to 99.9	nearest tenth digit (0.1)
100.0 to 999.9	nearest 1's digit (whole number)
1000 to 9999	nearest 10's digit

KAISER-HILL ROCKY FLATS, INC.
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
P.O. BOX 464
GOLDEN, COLORADO 80402

GENERAL LABORATORY
BUILDING 881

RADIOCHEMISTRY ISOTOPICS REPORT

SDG NUMBER: 96L2568

DATE: 07-30-96

Report Format Description

The sample isotopic activities and uncertainties are reported in the "Isotopic Analysis Results" section of the report. The result uncertainty in pCi/L or pCi/g is designated as the "+/-" value and represents the uncertainty at the 2 sigma level. The letter "D" prefix indicates a field duplicate sample (a sample which is taken in duplicate while in the field). This differs from a laboratory duplicate which is a sample analyzed in duplicate.

The associated QA/QC results for the CSL controls analyzed in each respective batch number are reported in the "Quality Assurance/Quality Control Data" section of the report. The "Analysis Date" refers to the date the analysis was completed.

Definition of Data Qualifiers

There are no data qualifier symbols defined for Radiochemistry. All qualified data are explained in the narrative section of this report. Qualified results may be flagged with "*" followed by an explanation.

Exceptions or Deviations to Base Methods

Depending upon the sample matrix and if there are solids or particulates present, deviations from procedure L-6235 or L-6266 may be required. These deviations are detailed in a procedure filed with the raw data.

Narrative for 96L2568

Fifteen OU9 Soil sample was delivered to the lab for the analysis of Plutonium, Americium and Uranium. The soils were run according to procedure L-6266, and L-6235. The samples were split into two batches. This report will be amended at a later time to include the batch currently being run. MDAs are slightly elevated due to the small sample size of 0.5 grams. This however does not affect the results of the analysis due to the values being above the reported MDA. Samples are reported in dry weight. Wet to dry ratios can be

KAISER-HILL ROCKY FLATS, INC.
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
P.O. BOX 464
GOLDEN, COLORADO 80402

GENERAL LABORATORY
BUILDING 881

RADIOCHEMISTRY ISOTOPICS REPORT

SDG NUMBER: 96L2568

DATE: 07-30-96

found in the raw data. All samples ran well with no problems to report.

If there are any questions feel free to call me at 7128.

Chemist Approval

N.K. Harward

Date

Chemist Review

K.M. Hagglund

Date

38/38 36/36